LAP-485PC PROTOCOL CONVERTER

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LAP PROTOCOL CONVERTER
LAP-485PC

LAP-485PC

Modbus RTU/ASCII (LAP-485) to Modbus TCP (Ethernet)

LAP-485PC is a microcontroller unit. It is designed to exchange data over the Ethernet 10BASE-T and 100BASE-T network using the equipment, which is provided with the LAP-485 interface and establishing a Modbus network. The standard network mapping using the 485 is provided in. The unit fulfills the functions of a 'Modbus Server' for switching the Modbus clients to the Ethernet network. It redirects the Modbus requests from the clients to the units in the Modbus network and returns their answers to the clients.

Functioning

32-bit RISC processor with ARM architecture provides data routing between the Modbus RTU/ASCII (LAP-485) network and Ethernet (10base-T/100base-T) network. The operating speed and availability of channels for direct access to the memory allows processing the high-speed data flow. Indicators provide information on the connection status and data transfer over the Modbus and Ethernet networks. The "Reset" button allows of restart the unit, without switching it off the mains, or do a factory reset.

The unit has non-volatile memory to save settings. Every unit is provided with a globally unique MAC address (during the production) and can be connected to local networks with a protected access to Internet.

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CAUTIONS

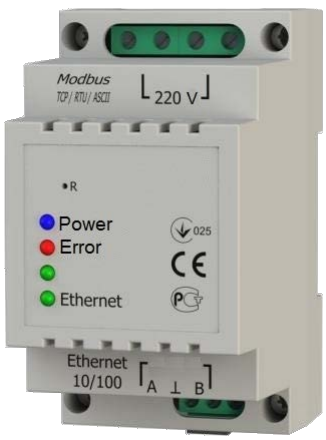
•Carefully study the user manual before using the appliance.
•Place the unit under operating conditions and wait at least 2 hours before connecting it to the electricity mains.
•Do not use abrasives or organic compounds (alcohol, gasoline, solvents, etc.) for cleaning.

DO NOT OPEN AND REPAIR THE EQUIPMENT YOURSELF.
It may contain energized parts.

DO NOT OPERATE THIS UNIT IN CASE OF ANY MECHANICAL DAMAGE TO THE CASING.

DO NOT EXPOSE THIS PRODUCT TO WATER OR OPERATE IN A HIGH HUMIDITY ENVIRONMENT.

This is a safe in service unit if complying with operating procedures.



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Terms and abbreviations

- **10Base-T – Ethernet standard for twisted pair communication with the speed of 10Mbit/s;**
- **100Base-T – Ethernet standard for twisted pair communication with the speed of 100Mbit/s;**
- **8P8C/RJ45 – is an unified socket for 10Base-T / 100Base-T network connections;**
- **Twisted pair – is a pair of insulated conductors inside the cable, which are twisted together in order to reduce the distortion of the transmitted signal;**
- **Indicator – is a LED element;**
- **Client – is a device, which is addressing the other devices (server) with a request to perform certain functions;**
- **Package – is a block of data to be transmitted between devices;**
- **Unit – is the LAP-485PC Protocol converter;**
- **Server – is a unit, which performs specific functions at the request of other units;**
- **ASCII – is a table of standard codes for information interchange;**
- **Ethernet – is a standard for packet network communication and transmitting data between units (e.g., PCs);**
- **HTTP – is a protocol for transferring Web-pages and other data over "client-server " technology;**
- **Internet – is a global routing system of units for storing and transferring data;**
- **IP (protocol) – is a routable protocol for transferring data over Ethernet. It is a part of TCP/IP and used for Internet;**
- **IP (address) – is a node address, which is unique within a single network, operating over the IP protocol;**
- **IPv4 – is a four byte IP-address;**

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- **MAC (address) – is an address, used for device authentication during Ethernet transmissions. It is usually unique although qualified personnel can change it under certain circumstances.**
- **MAC-48 – is a six byte MAC-address;**
- **Modbus – is a standard and protocol for packet communication over the "client-server " technology for industrial electronic units;**
- **Modbus RTU – is a communication protocol of the unit for bite wise transfer of the package;**
- **Modbus ASCII – is a communication protocol of the unit for the transfer of package in the form of ASCII-symbols;**
- **Modbus TCP – is a protocol for transferring Modbus packages under the TCP/IP standard;**
- **LAP-485/EIA-485 – is a network standard for communicating units over the twisted pair;**
- **TCP/IP – is a standard and a set of protocols for transferring data along the networks with delivery verification;**
- **WEB – is a system for accessing documents on the server, used in the Internet.**
- **WEB-page – is a document, file, recourse, which is available on the Web-server;**
- **WEB-browser – is a WEB-server client for accessing the WEB-pages, which is primarily using the HTTP protocol.**

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1 PURPOSE

LAP-485PC is a microprocessor unit.
It is designed to exchange data over the Ethernet 10BASE-T and 100BASE-T network using the equipment, which is provided with the LAP-485 interface and establishing a Modbus network. The standard network mapping using the LAP-485PC is provided in Fig.1.
The unit fulfills the functions of a Modbus-server for switching the Modbus-clients to the Ethernet network. It redirects the Modbus-requests from the clients to the units in the Modbus network and returns their answers to the clients.
LAP-485PC has:
•flexible addressing within the Ethernet network (overloading MAC-address, static and dynamic IP-address);
•access protection over the Ethernet network (password for configuration mode, IP-address filter for setting and switching to the Modbus network);
•different data transfer modes for Modbus network (RTU and ASCII with/without odd-even check, wide range of transmission speeds, selectable delay)

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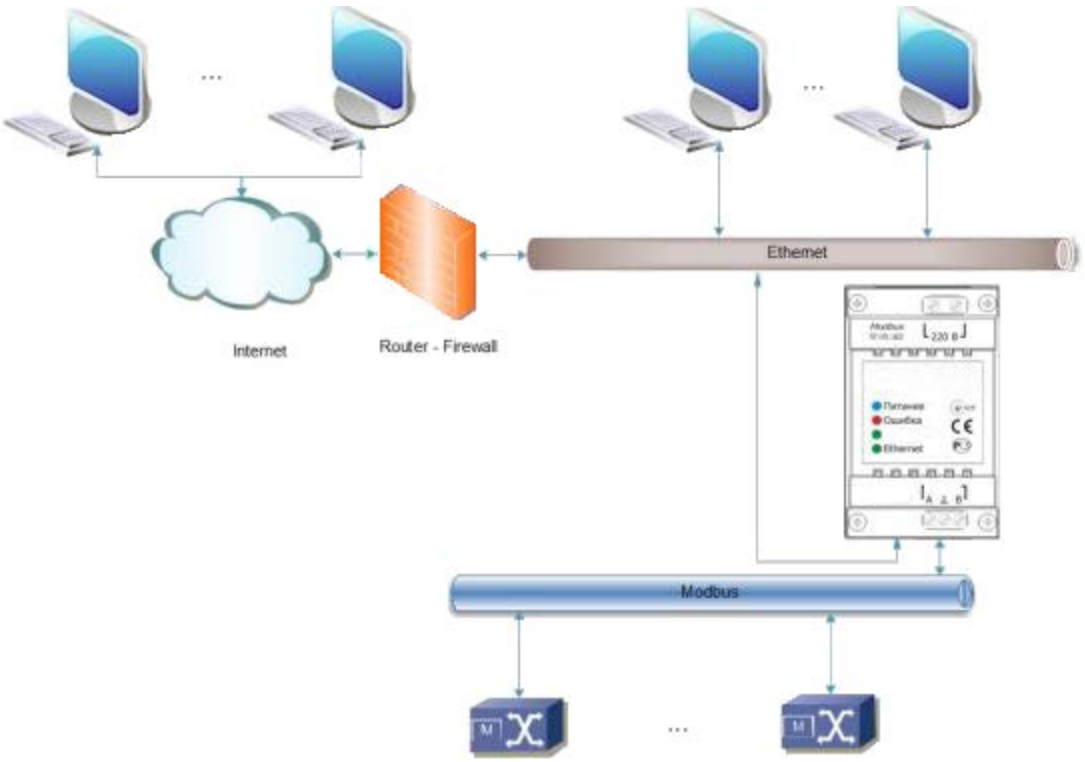

Figure 1 – Network mapping with the unit

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2 SPECIFICATIONS

2.1 Main specifications

Main specifications are resulted in Table 1.

Table 1 – Main specifications of the unit

Operating supply voltage, VAC	220
Voltage to maintain normal operation, V - alternating current - direct current	 100 – 250 140 – 350
Supply frequency, Hz	47 – 63
Data Exchange Interface over the Ethernet network	10BASE-T/100BASE-T (twisted pair)
Supported Ethernet protocols	Modbus TCP, HTTP
Maximum number of connections over the Modbus TCP protocol	11
Integrated servers	Modbus-server, HTTP-server
Data Exchange Interface over the Modbus network	
Supported Modbus protocols	Modbus RTU, Modbus ASCII
Maximum number of connected units within the Modbus network	32
LED	
Readiness time upon switching the unit to the mains, sec, no more than	1
Utilized current (in case of 220 V), mA, at most	10
Weight, kg, at most	0.200
Dimensions, mm	95 x 52 x 67
Unit purpose	Communication equipment
Nominal operation condition	continuous
Terminal bus specifications - cross-section of switched conductors, mm^2 - maximum effort (torque) on screw terminals, Nm	 0.3 – 3 0.4
Level of protection: - unit - terminal bus	 IP30 IP20
Protection class against electrical shock	II
Climatic version	УХЛ3.1
Permissible pollution density	II
Overvoltage category	II
Rated insulation voltage, V	450
Rated impulse withstand voltage, kV	2.5
Operating position	arbitrary
Pollutants in the amount, which is not to exceed the maximum permissible concentration	none

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2.2 Operating conditions

This unit is designed to operate (or to be stored) under conditions resulted in Table 2.

Table 2 – Operating and storage conditions

Operating temperature, °C	from minus 35 to +55
Storage temperature, °C	from minus 45 to +70
Atmospheric pressure, kPa	from 84 to 106.7
Relative air humidity (at 25°C), %	from 30 to 80

3 STRUCTURE AND FUNCTIONING

3.1. Structure

3.1.1. Design

The unit has a standard plastic case, which can be attached to the DIN-rails with the width of 35 mm. The unit drawing, together with the overall and setting dimensions, is provided in Figure 2.

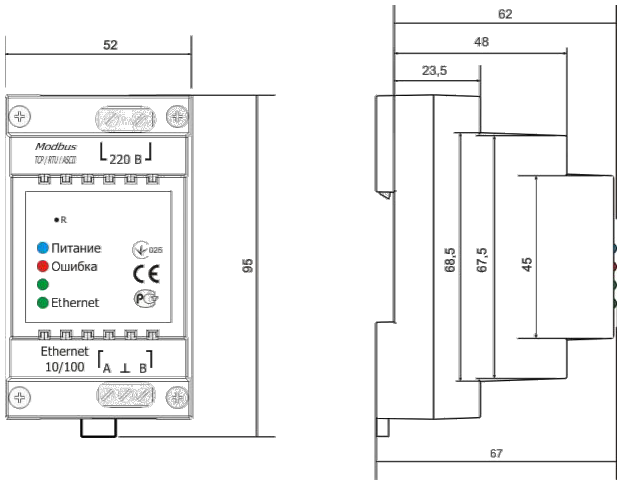

Figure 2 – Overall dimensions of the unit

3.1.2. Display and control

The front panel of LAP-485PC is provided in Figure 3.
1 – Reset button "R" is designed to restart the unit or factory reset.
2 – Power indicator «Power» is activated if supply voltage is available.
3 – Error indicator «Error» warns about errors (to include format errors of incoming data packages).
4 – Indicator «LAP-485» is activated while waiting a reply from the unit in the Modbus network; is flashing while data exchange over the Modbus network.
5 – Indicator «Ethernet» is activated when connected to the Ethernet network; is flashing while data exchange over the Ethernet network.

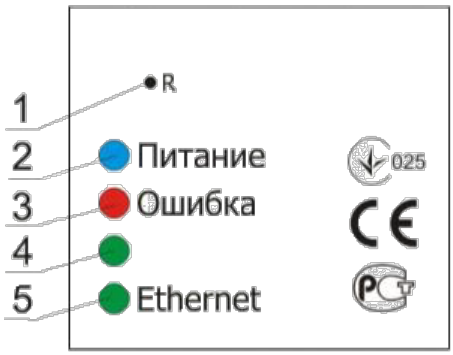

Figure 3 – Front panel of LAP-485PC

3.2. Functioning

Simplified structural diagram of the unit is provided in Figure 4.
32-digit RISC-processor with ARM architecture provides data routing between the Modbus RTU/ASCII (LAP-485) network and Ethernet (10base-T/100base-T) network. The operating speed and availability of channels for direct access to the memory allows to process the high-speed data flow.

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Indicators provide information on the connection status and data transfer over the Modbus and Ethernet networks. The "Reset" button allows of restart the unit, without switching it off the mains, or do a factory reset:
•to do a factory reset – press and hold down the reset button "R" for 8 seconds; "Error" indicator shall be activated in 2 seconds; the unit shall be restarted and the indicator "LAP-485" shall be activated and deactivated after 8 seconds of holding down the button; release the "R" button;
•to reset the unit while saving user configurations – press and hold down the reset button "R"; release the "R" button when "Error" indicator shall become activated.
Note – when restarting the unit, the clients may need to renew the connections.

The unit has a memory to save settings. Every unit is provided with a globally unique MAC-address (during the production) and can be connected to local networks with a protected access to Internet.

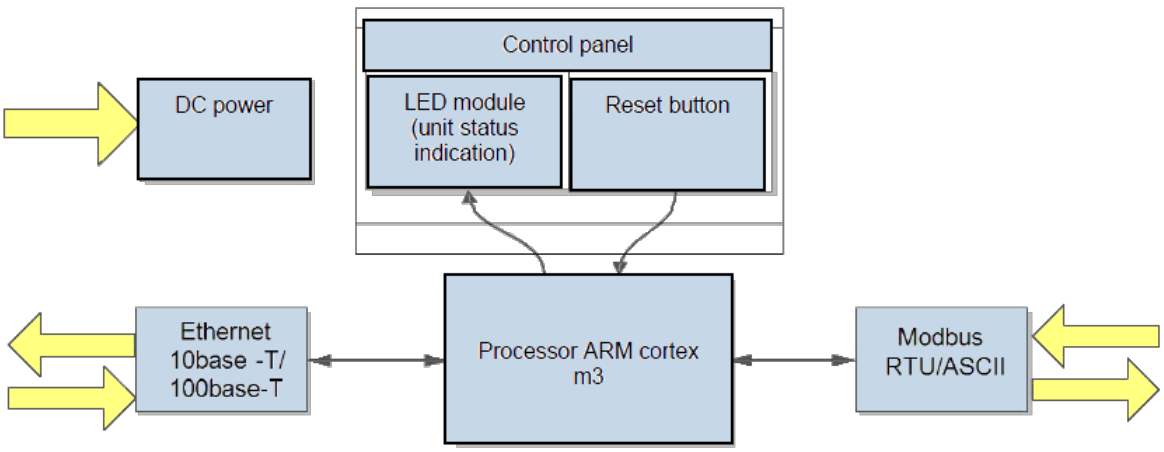

Figure 4 – Structural diagram of the unit

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4 MAINTENANCE AND SAFETY MEASURES

4.1 Safety measures

4.1.1 LAP-485TC IS OPERATING A POTENTIALLY LETHAL VOLTAGE; Power off the unit, as well as any other units connected to it, before maintenance, trouble-shooting or installation works.
4.1.2 The unit is not designed for operation under impact or vibration conditions.
4.1.3 Do not expose the inner electric components of the unit, as well as input contacts of terminal blocks and sockets, to water.
4.1.4 Do not operate the unit in aggressive environment with the presence of acids, alkalies, oils, etc. in the air.
4.1.5 Switching, adjustment and maintenance of the unit should be conducted by the qualified personnel, who is familiar with the provisions of this user manual.
4.2.6 The following regulations should be enforced while operating and maintaining the unit: GOST 12.3.019-80, "Operational regulations of Electrical Installations", and "Safety Regulations for the Operation of Electrical Installations".

4.2 Maintenance procedure for LAP-485TC

Suggested maintenance interval – every six month.
The maintenance procedure includes visual inspection to verify the connection of cables to the LAP-485TC terminals, as well as the absence of fractures and cracks on the case.
All safety regulations provided under section 4.1 should be enforced during the maintenance.

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5 SWITCHING OF LAP-485TC

The unit is switched according to the diagram, see Fig. 5.

1) Switch the cable connection with Modbus network (twisted pair cable of Cat.1 or higher) to the “LAP- 485" socket and Modbus network (or directly to the unit with LAP-485 interface).

Note: Contact “A” is designed for transferring non-inverted signal, while contact “B” is used for the inverted signal.

2) Switch the cable connection with Ethernet network (supplied) to the “Ethernet” socket and Ethernet network. Any connection peculiarities depending on the type of network are resulted in Appendix A.

3) Switch the power cable connection (copper stranded conductor cable with the cross-section of 0.75 mm2 and maximum operating voltage of no less than 380V) to “220V” socket, and then connect the cable to the power supply 220V, 50 Hz.

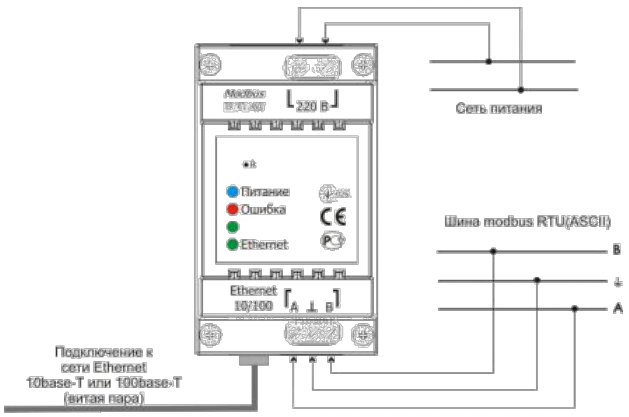

Figure 5 – Unit connection diagram

6 OPERATING LAP-485PC

6.1. General information

Powering up the unit will activate "Error" and “LAP-485" indicators, while the unit shall start initiating transceivers. Both indicators become deactivated in 0.5 seconds and the unit proceeds to perform the server functions (Ethernet network connection may take more time depending on the settings of the unit as well as other units connected to the network).
WARNING! CONTINUOUS ACTIVATION OR FLASHING OF “ERROR” INDICATOR IN THE ABSENCE OF CONNECTIONS TO THE UNIT INDICATES UNIT MALFUNCTION.
Ethernet network connection pending. The network connection is established, if “Ethernet” indicator becomes activated. Flashing of “Ethernet” indicator stands for transmitting data over the network.

6.2. Operating LAP-485PC over the HTTP protocol

LAP-485PC waits for a connection to an Ethernet network using the HTTP protocol on port 80. PC connection can be established using the WEB-browser.
When a client connects to port 80, the unit starts expecting requests for HTML-pages. These requests may contain certain parameters. In case of a valid request, those parameters are processed and the client receives the text of a selected HTML-page. In case of a request without an indication of certain page, the client is returned to the title page. When the page is transferred, the unit deactivates the client and awaits for further connection.

6.3. Operating LAP-485PC over the Modbus TCP protocol

While operating, the LAP-485PC waits for a connection to an Ethernet network using the Modbus TCP protocol on port 502. The connection port for Modbus TCP can be changed by the user. PC connection can be established using any software – Modbus TCP of the clients.

When a request for client connection to the Modbus TCP port is received, the unit starts verifying the client's IP-address (if connection filtering over IP is activated). If this address does not correspond with the preset value, the connection is rejected. Otherwise, the unit starts checking the list of available connections. In case of no available connections, the unit (depending on the configuration) can connect a new client instead of the previously connected one (if no activity of the client was registered over a set period of time, or if the connection is maintained longer than prescribed).
When a client is connected to a Modbus TCP port, the unit adds it to the internal list of clients (the number of clients cannot be greater than provided under specifications). In case of any request from the client, if the request is addressed to LAP-485PC, the unit processes it and provides a response to the client. If the request is addressed to another unit, the unit sends the request into the Modbus network and waits for a response from a unit on the network ("LAP-485" indicator is activated in this case). "LAP-485" indicator is deactivated if the data is received or the waiting time is out. If the response is provided in a proper format, LAP-485PC transmits it to the client that requested it. In case of any format errors, an "Error" indicator shall become activated for 0.5 seconds and no response is provided to the client. If no response is provided, LAP-485PC generates and transmits the proper Modbus exemption code to the client (code 11).

7. SETTING

7.1 General information

All parameters are saved at the power off.
Unit configuration can be done in two ways:
•through WEB-interface
•through Modbus-interface

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WARNING! ANY CHANGES IN UNIT CONFIGURATION MAY RESULT IN BLOCKING OR OBSTRUCTION WHILE TRYING TO REACH THE UNIT OVER THE NETWORK.
In this case, all parameters should be factory reset (see Section 3.2).

7.2 Parameters of LAP-485PC

A collection of parameters available via Modbus protocol is provided in Table 3 . The inner structure of any collection of parameters is similar to the structure of collection, which is described in table 7 (apart from start-address).
The presentation format of parameters in Modbus registers is detailed in Table 4.
All parameters to control the current operating mode of the unit (available for read and write) are provided in Table 5.
All parameters to determine the current condition of the unit (available for read-only) are provided in Table 6.
All parameters available in the configuration mode only are provided in Table 7.

Table 3 – Collection of parameters available via Mobdus protocol

Collection	Description	Access	Address
Acting settings	Current unit configuration	In any mode, read-only	200-262
Saved settings	The collection is saved regardless of power supply and further used as the restart.	In configuration mode only, read-only	300-362
Factory settings	Fixed collection, which can be activated as shown in sections 7.3 and 7.4	In configuration mode only, read-only	400-462
Changeable settings	All parameters in Table 7, which can be modified and incorporated as described in Section 7.4	In configuration mode only, reading and writing	500-562

Table 4 – Presentation format of parameters in Modbus registers

Parameter	Range of values	Description	Number of Registers
Number	0-65535	Integer (16 bits) in a standard range of Modbus register	1
Number	0-4294967295 in two registers, upper part – first	Integer number, which can not exceed the limit for Modbus register (65535)	2
Character string	In every register – ASCII character code or 0 (end of string)	Set of values, each of which is equal to code 1 of the ASCII character (see Appendix B) If the string is shorter than maximum length, last character is followed by the code 0.	Maximum length of the string for the given parameter
IP-address (IP-mask)	In every register – one byte (0-255)	A set of four byte IPv4 address, from left to right	4
MAC-address	In every register – one byte (0-255)	A set of six byte MAC-48 address, from left to right	6

Table 5 – Parameters to control the current operating mode of the unit

Parameter	Min – Max	Initial value	Description	Address
Entering password	String of characters	0	Configuration mode is available upon entering the valid password	100-119
Control command	0-3, writing in the configuration mode	0	0: no activity 1: «Restart» – unit restart 2: «Save» – save the changed settings on the Modbus 3: «Factory reset» – reset the unit to factory settings	120

Table 6 – Parameters to determine the current condition of the unit

Parameter	Description	Address
Mode	0: User mode 1: Configuration mode	121
Current IP-address	IP-address of the unit in Ethernet network	122-125
Current MAC-address	MAC-address to authenticate the unit in Ethernet network	126-131
Number of Modbus TCP clients	Number of connections provided over the Modbus TCP protocol	132
Maximum number of Modbus TCP clients	Total number of possible connections to Modbus TCP	133
Time, min	Number of minutes since the start	134-135
Modbus TCP loading, requests/sec	Number of requests processed in a second	136
Number of Ethernet network congestions	Number of incoming buffer overflows for Ethernet (which may result in a data loss) – since the start	137
Number of communication errors	Number of identified errors (connection/communication) after which the work was continued, - since the start	138
Number of periodic restarts	Number of preset restarts – during the whole period of operation	139
Number of critical errors	Number of identified errors (failures) resulting in a restart of the unit - during the whole period of operation	140

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Table 7 – Unit configuration settings

Parameter	Min – Max	Factory setting	Description	Address
Addressing in the Ethernet network				
Static IP-address	IP-address	192.168.0.111	IP-address of the unit in Ethernet network shall be equal to this value if dynamic addressing is disabled or not available.	500–503
Subnet mask	IP-mask	255.255.255.0	Used only together with a static IP-address	504-507
Gateway	IP-address	192.168.0.1	Used only together with a static IP-address, or as an IP-address filter for DHCP-server	508-511
Enable dynamic addressing via DHCP-server	0-1	0	0: preset IP-address, mask and gateway is used for addressing in Ethernet. 1: DHCP network server is used by the unit to determine IP-address, mask and gateway. The parameters for static addressing are used if server is unavailable	512
Enable IP-address filter of the DHCP server	0-1	0	Used if dynamic addressing is enabled. 0: unit receives addressing data from the first DHCP-server to respond 1: unit receives addressing data only from DHCP-server with IP-address of the gateway	513
Enable manually set MAC-address	0-1	0	0: unique value for every unit, stored in the memory shall be used as a MAC-address 1: manually set value is used for MAC-address	514
manually set MAC-address	MAC-address	Unique for every unit	Used if manually set MAC-address is enabled for the authentication of unit in the Ethernet network	515-520

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Parameter	Min – Max	Factory setting	Description	Address
Switching to Ethernet network				
Connection port for Modbus TCP	1-65535	502	Used in case of TCP-connection to the unit via Ethernet to exchange data over Modbus TCP protocol	521
IP-address of the primary client	IP-address	192.168.0.2	IP-address, for which one connection via Modbus TCP is reserved. Address, which is used for unit configuration.	522-525
Enable the IP-connections filter for configuration	0-1	0	0: setting parameters via Modbus-interface or WEB-interface from any address (password protected) 1: setting parameters via Modbus-interface or WEB-interface is only allowed from the IP-address of the main client	526
Enable the IP-connections filter over Modbus TCP	0-1	0	0: Modbus TCP connections are available from any address 1: any Modbus TCP connections are available only from the IP-address of the main client	527
Enable replacement of non-active clients	0-1	1	0: Modbus TCP connection is maintained regardless of the time period between requests from the client 1: if all connections to Modbus TCP are busy, the new client, requesting for a connection, can be connected instead of the client, who provided no requests over the longer then preset period	528
Maximum query timeout, sec	0-9999	90	Used, if replacement of non-active clients is enabled	529
Enable the queue for the last busy Modbus TCP connection	0-1	0	0: Modbus TCP connection is maintained regardless of the connection hold time 1: if all connections to Modbus TCP are busy, the new client, requesting for a connection, can be connected instead of the last connected client, if the hold time is more than a preset time	530
The maximum hold time of the last connection to Modbus TCP, msec	0-600,000	60,000	Used, if the queue is enabled for the last connection to Modbus TCP	531–532

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Parameter	Min – Max	Factory setting	Description	Address
Modbus network				
Own Modbus-identifier of the unit	0-247	111	0: unit forwards all Modbus TCP requests into the Modbus network, unit registers via Modbus TCP are unavailable 1–247: units responds to Modbus TCP requests bearing the given Modbus-identifier without forwarding them to the Modbus network	533
Bit rate in Modbus-network, bit/sec	75 – 1,500,000	9,600	Used in case of data exchange between the units in Modbus-network, the same value for all units in Modbus-network	534-535
Enable the odd-even check	0-1	0	Used in case of data exchange between the units in Modbus-network, the same value for all units in Modbus-network 0: unused, byte is completed with 2 stop bits 1: byte is completed with parity bit and 1 stop bit	536
Enable the odd-even check (to verify odds)	0-1	0	Used in case of data exchange between the units in Modbus-network, if odd-even check is enabled. The same value for all units in Modbus-network 0: Parity check 1: Imparity check	537
Response time from Modbus RTU, msec	0-60,000	200	Used in case of data transfer via the Modbus-network in RTU mode. Waiting for a response is terminated if the first byte of the response has not been received within the given time after sending the request. The response is always expected longer then time of silence between frames (time of silence depends on the bit rate and shall be equal to the time required for transmitting 3.5 bytes, or 1.75 msec for bit rate over 19,200 bits/sec).	538
Enable ASCII exchange in Modbus network	0-1	0	Exchange mode in Modbus-network, the same value for all units in Modbus-network 0: RTU exchange mode (format: 1start bit, 8 data bits, 1 parity bit or stop-bit or 1 stop bit – total 11 bits). 1: ASCII exchange mode (format: 1start bit, 7 data bits, 1 parity bit or stop-bit or 1 stop bit – total 10 bits).	539
Response time for subsequent Modbus ASCII character, msec	0-60,000	1000	Used in case of data transfer via the Modbus-network in ASCII mode. Waiting for a response is terminated if the subsequent byte of the response has not been received within the given time, as indicated for the reception of response. Waiting time shall not be less then time required for transmission of a single character (depending on the bit rate).	540

Parameter	Min – Max	Factory setting	Description	Address
Miscellaneous				
Enable periodic restart of the unit	0–1	0	0: periodic restart disabled 1: unit restarts at a specified interval of time	541
Unit restart interval, min	5-7200	7200	Used if periodic restart of the unit is enabled	542
Password to enter the setup mode	String of characters	11111	Used to access the setup mode for Modbus TCP. Any string of 5 to 20 characters can be used as a password. It may not contain spaces or special characters listed in quotes below: «; : " < > * + = \ | / ? ,»	543-562

7.3 Configuring LAP-485PC through WEB interface

WEB-browser is used for setting via WEB-interface.
Write the unit IP-address in your browser (factory setting - 192.168.0.111) and proceed to the specified address.
Note: If the browser is set to use the proxy server, the access to the unit over local network shall be granted only after adding the IP- address into the exceptions list as indicated in the browser documentation.
This will open home page with tabs for transferring into the other modes.
Select “Settings” to start the configuration of unit Ethernet network.
Password request shall appear before granting access to setup mode (factory setting 11111).
Enter password and press "Enter". If the password is correct, you shall be granted access to the setup mode. Settings page appears with a list of parameters detailed in Table 7. If the password is incorrect, the password request shall be displayed once again.
Click "Save" after making changes to the settings. This will check all the changed parameters. If no errors is detected, new parameters will be stored in the memory (new parameters will become effective upon the following restart/activation of the unit). In case of any errors detected upon clicking the "Save" button, none of the parameters is saved, while the names of erroneous parameters are highlighted in red.

Click "Factory reset" to restore the default value of parameters.
Click "Restart" to stop all connections and interrupt all receive/transmit operations, with the following restart of the unit. In case of any changes to the parameters, either introduced or stored in the memory, these changes shall be implemented.

Note: If the addressing parameters in Ethernet network (MAC-address, IP-address, DHCP settings) are modified and saved, the browser may not load the page after the restart of the unit by pressing the "Restart" button. This can happen as the browser continues to reply over the previous address. In this case, the connection should be made anew.

Clicking the "Exit" button the will close the setup mode and a password request appears once again.

7.4 Configuring LAP-485PC through Modbus interface

Setting via Modbus-interface shall be provided if the unit is connected over the Modbus client, which is supporting the Modbus TCP protocol. The connection is established using its IP-address (factory setting - 192.168.0.111) with the indication of Modbus-identifier (factory setting - 111). Write the password string into the password input register (see Table 5) before setting parameters. Factory set password – is 11111, i.e. write 49 (ASCII-code for one) to record the factory set password to registers 0 - 4. If the password is correct, the mode register (see Table 6) takes the value of 1 – setup mode.
The instruction register (see Table 5), as well as registers for the collection of Modbus customizable parameters (see Table 7) are available for writing in the setup mode. When the required value is written to the registers of customizable parameters, write 2 (instruction for "Saving") in the instruction register. The accuracy of values for the stored parameters can be checked by comparing the collections of customizable parameters and saved parameters. If collections are the same, new values and settings shall be accepted and saved.

To reset the saved parameters to factory settings, write 3 (instruction for "Restoring to factory") in the instruction register.
Restart the unit for the saved settings to take effect. To restart via Modbus interface, write 1 (instruction for "Restarting") in the instruction register.
To exit the setup mode, write 0 instead of any character in password input register. This will clear all the password input registers and instruction register (turn the values to 0).

8 COMPLETE SET

LAP-485PC is supplied with:

•LAP-485PC protocol converter	**1 piece**
•User manual, passport.	**1 piece**
•Cable for Ethernet connection	**1 piece**
•Shipping box	**1 piece**

9 TRANSPORTATION AND STORAGE

LAP-485PC in the shipping box should be stored indoors at a temperature of -45 to +70C and relative humidity of no more than 80% with no vapors available in the air, capable of producing harmful effect on the shipping box and unit materials.
When transporting LAP-485PC, the user should provide some protection against mechanical damage.

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APPENDIX A

Switching to Ethernet

WARNING! Switching the unit to Ethernet network requires mutual coordination of settings on the connected devices. Connecting the misconfigured unit to the network may affect the communication level of other units on the network. As a rule, all connections to a network of more than 2 units are carried out by the qualified personnel (network administrator) only.

1 IP-addressing

When units are communicating over Ethernet network using TCP/IP protocol, every unit is using a set of IP-addressing settings to identify the sender and receiver of the data. The unit memory contains a personal and unique, within a single subnet, IP-address (four bytes are written as four integers, separated by dots, in the range of 0-255), subnet mask, which is the same for all units within the subnet (written similar to IP-address), and IP-address of the gateway, which is used to communicate with other networks. Proper communication between units of a subnet is possible under several conditions:

1) All units of a subnet have similar mask. Most of small LANs are using 255.255.255.0 mask.
2) Mask starts with a group of bits set to 1, followed by a group of bits turned to 0.
3) All bits set to 1 in the mask are similar for all the IP-addresses of units in subnet and indicate the subnet address. 192.168 is most frequently used address in LANs for the mask 255.255.255.0. The third byte may be used as a subnet number in a complex LAN. In smaller LANs, the third byte is usually equal to 0.

4) A set of bits in IP-address of the unit, which is set to 0 in the mask, is unique to each unit within the same subnet .
5) In most cases, the unit like router, which is already communicating with other networks, is switched to the network. This unit often gets the following address 192.168.0.1, 192.168.0.100, or 192.168.0.101. In this case, other units in the network shall have this IP-address of the unit as the gateway address. This address is not necessary for communication between units in a subnet, and is only used to connect units of one subnet to units of other networks.
Factory addressing settings for LAP-485PC Interface Converter are listed in Table A.1.

Table A.1 – Factory settings for LAP-485PC addressing

Parameter	Value
IP-address	192.168.0.111
Subnet mask	255.255.255.0
Gateway	192.168.0.1

In order to communicate with LAP-485PC, which is set to factory settings, the client unit (or any other units on the same subnet) should have 255.255.255.0 as a mask and address starting with 192.168.0. The fourth byte of the address can take any value in the range from 1 to 255, except for 111. If the connection between LAP-485PC and a client unit is not provided directly but via a network with a number of units, the mentioned address can not be equal to any of the addresses of other units on the subnet . If network has several units with the mask and the first three bytes of the IP-address, which are different from those specified in Table A.1, or the LAP-485PC factory IP-address is already taken, the configurable unit should be temporarily removed from the network to avoid addressing conflicts and establish a communication between this unit and LAP- 485PC directly. This will allow to configure the unit and LAP-485PC for direct communication or switching LAP-485PC to the network.

2. Configuring the client unit

The unit addressing is set according to documents and software it uses. Below is an example of configuring the personal computer (PC) on Windows XP or Windows 7 to communicate directly with the LAP-485PC on factory settings.
Open the list of OS network connections to configure the network address in Windows. To do this, follow the steps below (mind the OS version):

For Windows XP:
1) Log in as administrator.
2) Select Start-Control Panel.
3) If control panel items are divided into categories, select "Network and Internet Connections".
4) Go to "Network Connections".

For Windows 7:
1) Log in as administrator.
2) Select Start-Control Panel.
3) If control panel items are divided into categories, select "Network and Internet".
4) Go to "Control Center Network and Sharing Center".
5) In the task bar (on the left), select "Change adapter settings".

Next, perform the following steps:
1) In the Connections window, select the desired connection via an adapter with the addressing that you want to change. Many computers have only one adapter and one connection, which will be displayed in this window. If the window shows several connections, select the connection you want , using the adapter name in the information on connection or contact your system administrator.

2) Click the icon of the connection with the right button, and select "Properties" in the drop-down menu. The Properties window opens (see Fig. A.3).
3) Select "Internet Protocol (TCP/IP)" from the list of connection components in the next window. Make sure that the component is enabled (flagged in the list) . Click "Properties". The TCP/IP properties window opens (see Fig. A.4).
4) Select "Use the following IP- address".
5) Specify the address in the "IP- address" field within the range from 192.168.0.1 to 192.168.0.255 (except for 192.168.0.111, which is used by LAP-485PC).
6) Specify "255.255.255.0" in the “Subnet Mask” field.
7) The fields "Default Gateway", "Preferred DNS-server", and "Alternative DNS- server" should be left blank.
8) Press "OK" to close the Protocol Settings window.
9) Press "OK" to close the Connections Settings window.
10) If prompted by the OS to restart the PC after closing the windows, answer yes.

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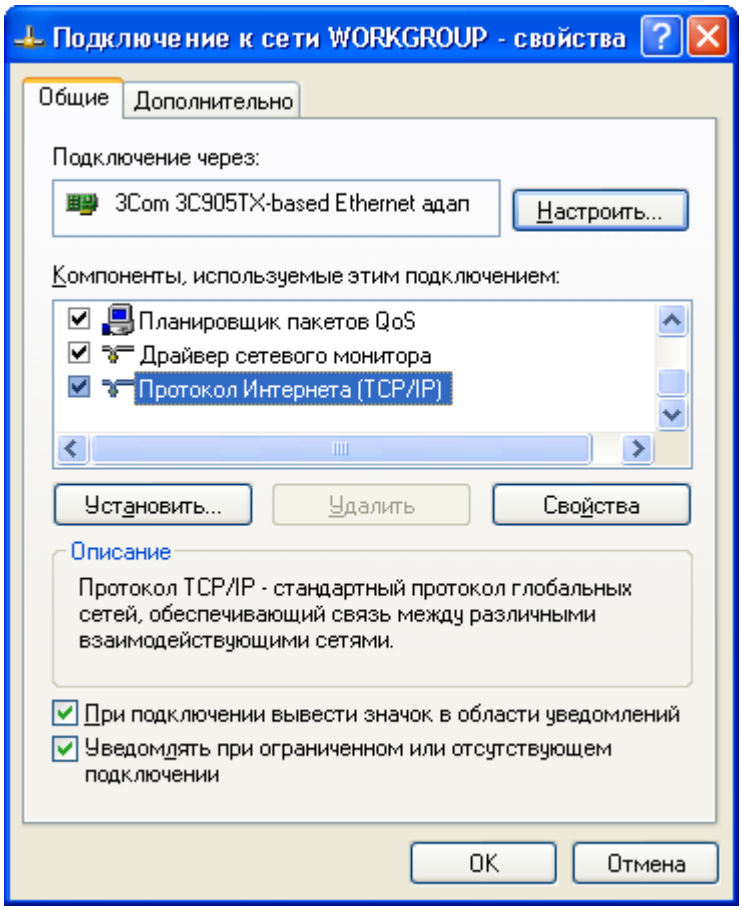

Figure A.3 – Connection properties window in Windows OS

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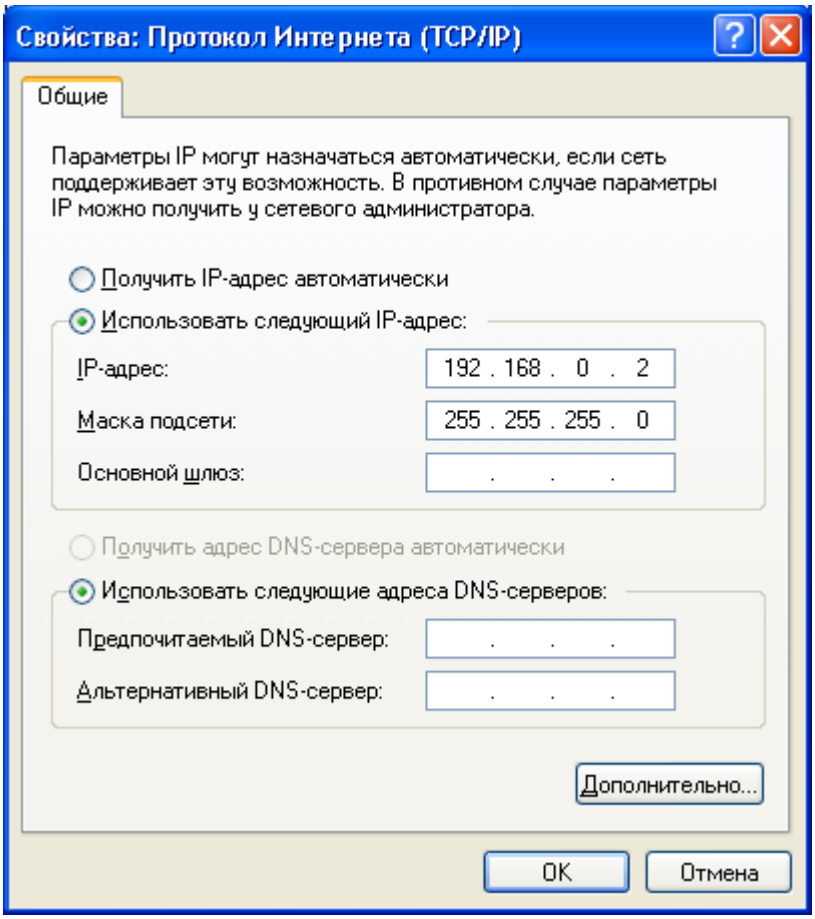

Figure A.3 – TCP/IP properties window in Windows OS

3. Switching to Internet

WARNING! The user is strongly recommended to connect the unit to Internet under the supervision of the LAN system administrator and/or representative of Internet service provider.

Use the following guidelines to connect the unit to Internet:

•acquire a dedicated line with a static IP-address from your Internet Service Provider (hereinafter referred to as – ISP);

•several connection options are possible if your ISP binds the connection to MAC-address, and the given Internet connection was already used by personal computers or other units:

a) connect the unit directly to the PC (see Section 5.2.1) to learn the MAC-address of the unit (see Section 7). Inform the ISP on the change of MAC-address to the MAC-address of the unit;

b) determine the MAC-address for Internet connection from the unit settings, which was previously using this connection, or acquire it from your ISP. Connect the unit directly to the PC and change the parameters "Enable manual MAC-address" and "Manually set MAC-address" to have the manual MAC-address enabled and values of the unit correspond to MAC- address with an Internet connection binded;

•direct connection of the unit to the ISP cable is not recommended; in case of a router connection, the ISP cable is connected to the "Uplink" socket on the router (It is usually marked with color and has no numbers. The marking depends on the router manufacturer, see the router documentation). The straight-through (supplied) Ethernet cable is used for connecting unit to the router. Set the router for Internet connection as per ISP recommendations using the router documentation. The router settings should also provide for the redirection of requests, which are coming to static IP-address provided by the ISP, to the unit IP-address (factory setting - 192.168.0.111);

•verify if the Internet connection is protected by standard means (see below);

•when referring the unit via Internet, use IP-address provided by your ISP.

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4 Protection of connection

•LAP-485PC has basic protection against unauthorized access over Ethernet.
•IP-address filter for configuration can be enabled to restrict access to HTTP and Modbus interfaces of the unit to a single specified address, without restricting access to the Modbus (LAP-485);
•IP-address filter for Modbus TCP can be enabled to restrict access via Modbus TCP to the Modbus network (LAP-485) and unit to a single specified address;
•unit settings can be changed remotely by entering the password (minimum 5 characters). Entering several incorrect passwords while trying to determine the correct one is blocked by the unit.
•when entering the password, all settings shall be only available to a given client using a given protocol. In case of no requests from the client over the long period, the access returns to locked mode.
Note: The setup mode is provided over an unprotected connection upon entering the correct password. The users are strongly recommended to enable the "IP-connections filter for configuration" option of LAP-485PC in case of network configuration (especially for networks without other types of protection).
•The unit protection system is not designed to counter malicious network attacks (especially those, which are not trying to get access to the unit but to block it instead);
•In case of complex and large networks (especially when providing access to the LAP-485PC via Internet), the users are recommended to separate the unit from unprotected networks with standard protective equipment (router, configured to filter the transmissions, Firewall, etc.).

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APPENDIX B

Character codes under ASCII standard

Code *	Character	Code *	Character	Code *	Character	Code *	Character	Code *	Character	Code *	Character
32	(space)	48	0	64	@	80	P	96	`	112	p
33	!	49	1	65	A	81	Q	97	a	113	q
34	"	50	2	66	B	82	R	98	b	114	r
35	#	51	3	67	C	83	S	99	c	115	s
36	$	52	4	68	D	84	T	100	D	116	t
37	%	53	5	69	E	85	U	101	e	117	u
38	&	54	6	70	F	86	V	102	f	118	v
39	'	55	7	71	G	87	W	103	g	119	w
40	(	56	8	72	H	88	X	104	h	120	x
41	)	57	9	73	I	89	Y	105	i	121	y
42	*	58	:	74	J	90	Z	106	j	122	z
43	+	59	;	75	K	91	[	107	k	123	{
44	,	60	<	76	L	92	\	108	l	124	|
45	-	61	=	77	M	93	]	109	m	125	}
46	.	62	>	78	N	94	^	110	n	126	~
47	/	63	?	79	O	95	_	111	o		

*** – all codes are provided in decimal numeration system.**

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